US Army Corps of Engineers
New England Division

Drought Contingency Storage Plan

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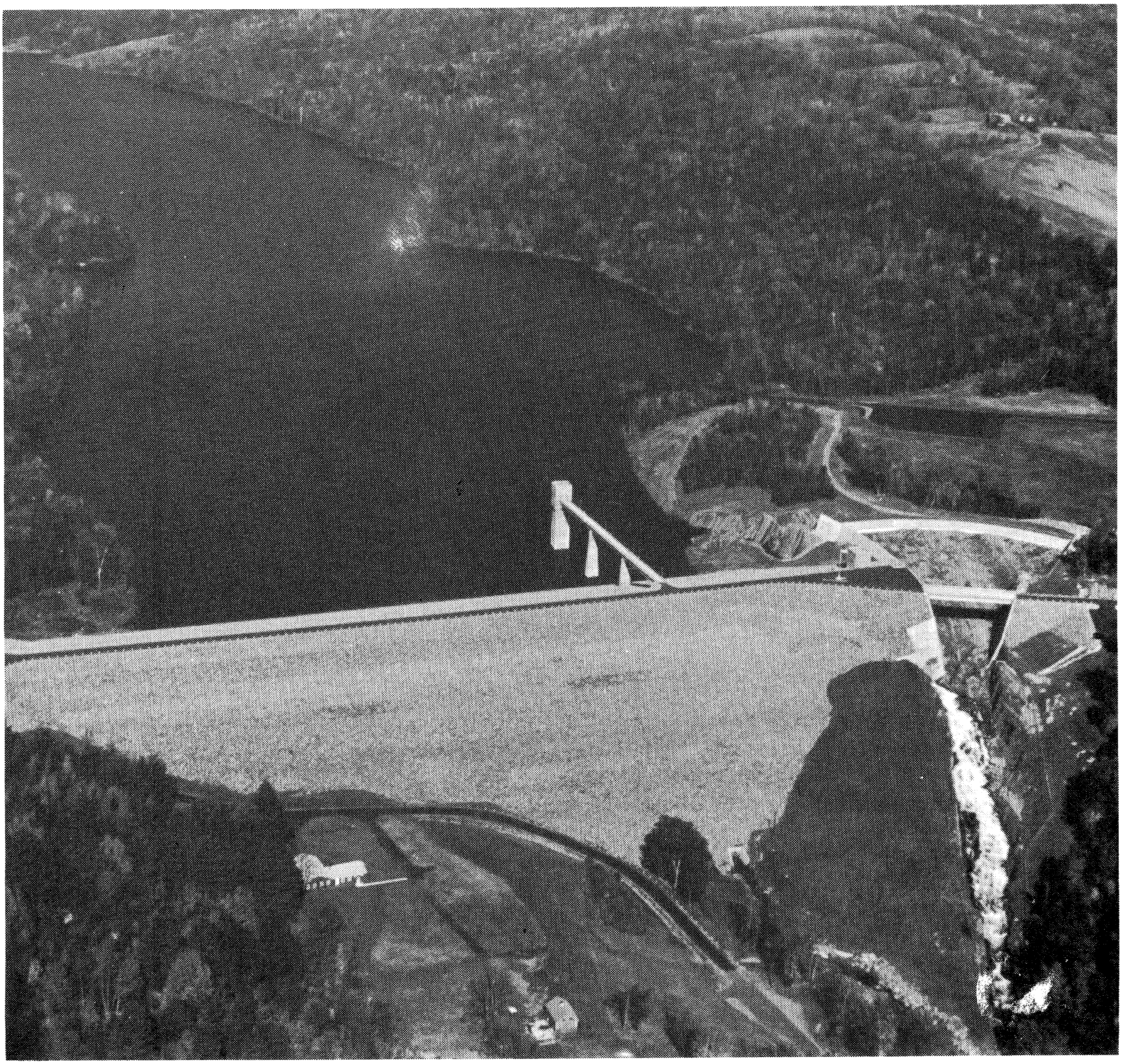
Littleville Lake, Chester and Huntington, Massachusetts



CONNECTICUT RIVER BASIN
WESTFIELD RIVER WATERSHED

DROUGHT CONTINGENCY STORAGE PLAN
LITTLEVILLE LAKE

1987

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
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SYLLABUS

This report is a compilation of basic information on the Corps of Engineers Littleville Lake to aid the assessment of the project as an emergency domestic water supply source. Included are sections on project description, operating procedure, available storage capacity, water quality, water supply systems in the region and potential impacts. It was not within the scope of the study to perform detailed analyses but mainly to address the emergency potential of the site and identify and discuss a variety of concerns to be considered in weighing Littleville Lake versus any other available sources of emergency supply. A review of all current applicable environmental, riparian or other laws would be required at the time of any decision to pursue drought contingency storage at the project. The Corps of Engineers would not consider drought storage activities at Littleville Lake without an official request from the Commonwealth of Massachusetts.

Littleville Lake is located on the Middle Branch, Westfield River in central Massachusetts in a region where 13 public water supply systems service about 174,000 people. Water supply storage is already included as a project purpose at Littleville Lake. The use of this storage and accompanying water rights belong to the city of Springfield. It has been estimated that the water resources at the site, in concert with the allotted storage would provide a dependable yield of about 17.5 MGD. Because of the city of Springfield's water rights, any supplemental drought contingency storage plans at Littleville, after commencement of a drought emergency, would most likely be precluded. Emergency supplemental drought contingency storage might be possible by filling some of the flood control storage above EL. 518 FT-NGVD during spring runoff if and when the project water supply storage is refilled to 518 FT-NGVD. It has been determined that infrequently, flood control storage in the amount of 3750 AC-FT (up to El. 530 FT-NGVD) could be made available seasonally (late spring - early summer) without significantly impacting on flood control operations.

Littleville Lake's water quality is good. Supplemental storage could slightly diminish the existing water quality, however with filtration and disinfection it would be acceptable for public water supply. Water supply withdrawals and minimum downstream releases from the project during a drought could affect aquatic life both in the reservoir and downstream. Any infrequent supplemental storage would impact on existing boat ramps and boat fishing access to the reservoir.

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1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a drought contingency storage plan of operation for Littleville Lake that would be responsive to public needs during drought periods and identify possible modifications to project regulation within current administrative and legislative constraints. This plan was based on preliminary studies utilizing readily available information. Included are a description of existing water supply conditions, the potential for allocation of reservoir storage within specified limits, an evaluation of water quality, a discussion of impacts on other project purposes, the effects on the environment, and summary and conclusions.

2. AUTHORIZATION

The authority for the preparation of drought contingency storage plans is contained in ER 1110-2-1941 which provides that water control managers will continually review and, when appropriate, adjust water control plans in response to changing public needs. Drought contingency plans will be developed on a regional, basin-wide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

Littleville Lake was authorized by the Flood Control Act of 3 July 1958, (Public Law 85-500, 85th Congress) in accordance with recommendations set forth in Senate Document 17, 85th congress. Provisions for water supply in the Littleville flood control reservoir was authorized under the Water Supply Act of 1958, Public Law 85-55, dated 3 July 1958. Construction on Littleville Lake was initiated in July 1962 and completed in October 1965.

4. PROJECT DESCRIPTION

Littleville Lake is a dual purpose flood control and water supply project located within Connecticut River Basin, on the Middle Branch, Westfield River in Huntington and Chester, Massachusetts. A map of the Connecticut River Basin is shown on plate 1 and a Westfield River watershed map is shown on plate 2.

At spillway crest (elevation 576 ft-NGVD), Littleville Lake has a total storage capacity of 32,400 acre-feet, of which 9,400 acre-feet (El. 432-518 ft-NGVD) is water supply storage for the city of Springfield and 23,000 acre-feet (El. 518-576 ft-NGVD) are for flood control. The flood control storage is equivalent to 8.3 inches of runoff from the project's 52.3 square mile drainage area. A capacity table is shown on plate 3.

The physical components of Littleville Lake consist of a rolled earth dam and dike, a chute spillway, and two separate outlet works for flood control and water supply. The flood control outlet works consists of an intake channel, two 4' wide x 8' high sluice gates, a flood control tower and a 374 foot long, 8-foot diameter horseshoe outlet tunnel. A 30-foot wide concrete weir with crest elevation at top of the water supply storage (518 Ft-NGVD), is located in the approach channel 80 feet upstream of the flood control gates.

The main components of the water supply system consist of; a 17.5 foot wide intake channel, a wet well tower intake structure with four 36" diameter multilevel sluice gates, an outlet conduit, and an outlet channel.

A summary of pertinent data for Littleville Lake is listed on plate 4.

5. PRESENT OPERATING CONDITIONS

a. Normal Periods. A 9,400 ac-ft (3,063 MG) water supply pool (El. 432-518 ft-NGVD) is owned by the city of Springfield and serves as a supplement to Cobble Mountain Reservoir, the city's principle water supply source. The water supply storage is maintained full year round and, during normal operation the water supply outlet remains closed with normal discharges made through the higher flood control outlets. The normal flood control outlet gate settings during the nonfreezing season are 2' and 2'. During the freezing season, if gate freezing becomes a problem, the two flood control gates are throttled to keep them submerged, with no significant rise in normal pool level (El. 518 ft-NGVD).

b. Flood Periods. Littleville Lake is operated in concert with Knightville Dam to reduce flooding along the Westfield River and with other projects within the Connecticut River Basin to reduce flooding further downstream along the Connecticut River.

Operations for floods may be considered in three phases: phase I - appraisal of storm and river conditions during development of a flood; phase II - flow regulation and storage of flood runoff at the reservoir; and phase III - emptying the reservoir during recession of the flood. The regulation procedures are detailed in Appendix H of the Master Water Control Manual for the Connecticut River Basin.

c. Regulating Constraints.

(1) Minimum Releases. During periods of flood regulation, a minimum release of about 10 to 20 cfs is maintained in order sustain downstream fish life. During non-flood periods, outflow generally equals inflow. Once water supply diversions have been initiated by the City of Springfield, a minimum downstream release of 5 cfs will be maintained from the water supply outlet works. (Reference: Massachusetts Water Resources commission, 3 February 1969 letter to COE.)

(2) Maximum Releases. The maximum non-damaging discharge downstream of Littleville is about 1,700 cfs. Releases at or near this rate can be expected whenever peak inflows have exceeded this value and climatologic and hydrologic conditions permit.

6. MONITORING OF HYDROLOGIC CONDITIONS

The Reservoir Control Center directs the reservoir regulation activities at 31 New England Division flood control dams and continually monitors rainfall, snowcover and runoff conditions throughout the region. When any of these hydrologic parameters have been well below normal for several months and it appears that possible drought conditions might develop, the Corp's Emergency Operations Center (EOC) will be so informed. The EOC will then initiate discussions with the respective Federal and State agencies and other in-house Corps elements to review possible drought concerns and future Corps actions.

7. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General. The area of concern is a portion of the western region of Massachusetts in the vicinity of Littleville Lake. Table 1 contains information about public water suppliers in this area based on information provided by the Massachusetts Department of Environmental Management, Division of Water Resources. Of the 17 communities viewed as potential users of water from Littleville Lake during drought conditions, 12 of the communities are served by public water supply systems. The city of Springfield water system was not included in this analysis since the existing water supply storage and water rights are already owned by Springfield and would take precedence over any drought contingency storage. No data is available for those areas dependent on private individual water supplies.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of Littleville Lake that could benefit from storage at the project, and to present the data in a manner portraying existing water supply conditions. Projections of future demands were not developed because this study addresses only modifications in the operational procedures at Littleville Lake in order to provide storage for water supply purposes when drought conditions exist, and not to meet normal water supply demands at some future date.

c. Public Water Suppliers. As noted in Table 1, the data given for each water supplier includes: community served, estimated population served by the system, source of supply (ground or surface water), average day and maximum day demands for 1984, estimated safe yield of the source, and any further information available on the source of supply. An analysis of the adequacy of existing sources during drought conditions has not been performed. The information is shown to present a summary of the existing water supply conditions for the western Massachusetts area.

Table 1
Major Water Suppliers - Western Massachusetts

Company or Agency	Town Served	Est. Population Served -- 1980	Source of Supply (SW/GW)	1984 Demand Avg. Day (MGD)	1984 Demand Max. Day (MGD)	Safe Yield (MGD)	Comments
	Becket		No central supply				
Blanford Water Dept.	Blandford	864	SW	0.08	0.16	0.50	Long Pond
Chester Water Dept.	Chester	650	SW	0.06	0.08	0.20	Austin Br. Res, Horn Pd.
	Chesterfield		No central supply				
Easthampton Board of Public Works	Easthampton	15,424	GW	3.46	5.19	6.50	Three wells, one wellfield
Holyoke Water Dept.	Holyoke	44,311	SW/GW	9.22	12.71	20.90	7 reservoirs, one well
Pequot Water Co.	Holyoke	213	GW	0.02	0.03	0.54	One well
Huntington Water Dept.	Huntington	1,000	SW/GW	0.09	0.14	0.29	Cold Brook Res., two wells
	Middlefield		No central supply				
	Montgomery		No central supply				
Northampton Water Dept.	Northampton	29,257	SW/GW	3.97	5.10	10.00	Three reservoirs, two wells
	Otis		No central supply				
Russell Water Dept.	Russell	1,200	SW/GW	0.31	0.34	0.35	Black Brook Res., one well
Southampton Water Dept.	Southampton	1,800	SW/GW	0.11	0.17	0.87	Manhan Res., one well
Westfield Water Dept.	Westfield	33,450	SW/GW	6.02	11.86	16.50	Granville Res., eight wells
Westhampton Water Co.	Westhampton	114	SW	0.02	0.03	0.06	Mt. Brook Res.
West Springfield Water Dept.	West Springfield	26,960	SW/GW	4.02	7.13	6.50	Bear Hole Res., four wells
Worthington Fire Dist.	Worthington	480	SW/GW	0.04	0.06	0.15	Two reservoirs, three wells

d. Population Projections. Population projections for communities in the study area are given in Table 2 to show population trends for each community potentially affected by a prolonged dry period. The population projections were provided by the Department of Environmental Management, but were developed by regional planning agencies encompassing communities in the vicinity of Littleville Lake. This information indicates areas of potential future growth in the western Massachusetts area.

8. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. There are several authorities that provide for the use of reservoir storage for water supply at the Corps of Engineers projects. They vary from the provision of water supply storage as a major purpose in new projects to the discretionary authority to provide emergency supplies to local communities in need. In addition, guidance contained in ER 1110-2-1941 direct field offices to determine the short-term water supply capability of existing Corps reservoirs that would be functional under existing authorities. Congressional authorization is not required to add municipal and industrial water supply if the related revisions in regulation would not significantly affect operation of the project for the originally authorized purposes.

b. Drought Contingency Storage. Littleville Lake already includes water supply storage as a project purpose. It has been estimated that the water resources at the site in concert with the allotted storage provides a dependable water supply yield of about 17.5 MGD. The use of this storage, and accompanying water rights, belong to the city of Springfield, therefore any supplemental drought contingency storage plans at Littleville following commencement of a drought emergency would likely be precluded. Emergency supplemental water supply storage might be possible by filling some of the flood control storage, above elevation 518 ft-NGVD, during spring runoff if and when the project water supply storage is refilled to 518 FT. NGVD.

It has been determined that, infrequently, flood control storage in the amount of 3,750 ac-ft (El. 530 FT-NGVD) could be made available seasonally (late spring - early summer) without significantly impacting on flood control or other water supply operations. This amount of storage (3,750 ac-ft), assuming it could be filled during spring snowmelt, would provide a supplemental water supply of 4.07 MGD for the following 10 month nonsnowmelt periood or 10.2 MGD over the following 4 month low flow summer season.

Other drought contingency measures might involve water conservation aaand/or the city of Springfield's reallocation of its water rights to other adjacent and needy communities.

Table 2
Population Projections - Western Massachusetts

Town	Actual 1980	1985	1990	1995	2000	Percent Change 1980-2000
Becket	1,339	1,480	1,680	1,910	2,060	53.85
Blandford	1,038	1,082	1,214	1,293	1,321	27.26
Chester	1,123	1,188	1,238	1,269	1,280	13.98
Chesterfield	1,000	1,106	1,199	1,288	1,318	31.80
Easthampton	15,580	16,172	16,641	16,974	17,229	10.58
Holyoke	44,678	42,667	41,728	41,853	42,607	-4.64
Huntington	1,804	1,867	1,973	2,050	2,114	17.18
Middlefield	385	420	449	469	478	24.16
Montgomery	637	757	847	893	913	43.33
Northampton	29,286	29,755	30,529	31,353	32,388	10.59
Otis	963	1,030	1,130	1,230	1,300	34.99
Russell	1,570	1,685	1,786	1,865	1,915	21.97
Southampton	4,137	4,642	5,106	5,535	5,740	38.75
West Springfield	27,042	27,988	28,772	29,261	29,583	9.40
Westfield	36,465	39,820	42,886	45,459	47,277	29.65
Westhampton	1,137	1,296	1,431	1,514	1,550	36.32
Worthington	932	1,003	1,073	1,129	1,161	24.57
	169,116	173,958	179,682	185,345	190,234	12.49

9. WATER QUALITY EVALUATION

a. Water Quality Classification.

The Middle Branch of the Westfield River above Littleville Lake has been classified by the Massachusetts Water Resources Commission as class A water. This is not a statement of the existing water quality conditions in the river but rather of the water quality goals for the Middle Branch of the Westfield River. A designation as to whether this section of the Westfield River is a warm water or a cold water fishery has not been made.

Class A waters are designated for use as a source of public water supply. Technical requirements for class A warm water fisheries include a minimum dissolved oxygen (DO) concentration of 5 mg/l and a maximum temperature of 83 degrees Fahrenheit. For cold water fisheries the minimum DO concentration is 6 mg/l and the maximum temperature is 68 degrees Fahrenheit. Other technical requirements for class A warm and cold water fisheries include total coliform bacteria not to exceed a log mean of 50 per 100 ml for a set of samples during any monthly sampling period, pH as naturally occurs, total dissolved solids not to exceed 500 mg/l, chlorides not to exceed 250 mg/l, sulfates not to exceed 250 mg/l, and nitrate not to surpass 10 mg/l as nitrogen.

There shall be no substances in concentrations that produce objectionable color, odor or turbidity or substances in concentrations that exceed the limits necessary to control eutrophication.

The waters shall be managed so as to prevent the discharge of toxic wastes in concentrations, quantities or combinations which may create a significant likelihood of an adverse impact on human health or acute or chronic toxicity to fish or wildlife.

b. Existing Water Quality.

The water quality data collected at Littleville Lake by New England Division indicates that the waters of the project are of good quality, usually meeting or exceeding the requirements of their Massachusetts class A designation.

Indicative of the project's good water quality are the consistently high DO levels, neutral pH levels, generally low levels of color and turbidity and the absence of sulfates, chlorides, nitrates or total dissolved solids in excess of class A criteria. Levels of algal nutrients are below the threshold concentrations to support algal blooms in an impoundment.

The principal concern identified by New England Division's water quality monitoring program is the high levels of mercury. Many mercury determinations at Littleville Lake have found detectable levels which exceed the maximum criteria for drinking water. However, the high mercury levels appear to be associated with naturally occurring conditions and there is no indication that aquatic life at the site is being harmed by these levels. When the water at Littleville Lake is used for public water supply, the mercury levels should be monitored.

Occasional elevated levels of iron and manganese have been recorded at Littleville Lake. While not a health hazard in a public water supply, iron and manganese cause taste and laundry staining problems. These intermittent dissolved metal concentrations are a result of natural conditions and will continue in the future.

c. Water Quality Requirements for Drought Storage.

In defining the water quality requirements for drought storage, there exists two conditions that must be met. The waters must satisfy state standards for surface waters and must be of a quality suitable for the water supply users. A water which meets Massachusetts class A standards would be made usable for public water supply after simple filtration and disinfection. The water quality required for industrial water supply depends on the specific industrial process involved. The water at Littleville Lake would always be of a quality suitable for firefighting or ground water replenishment.

d. Effects of Drought Storage.

Any supplemental water stored at Littleville Lake would be adequate for use in the municipal water supply after filtration and disinfection. However, the act of storing supplemental water at Littleville Lake may cause some degradation of water quality at the project.

With a potential proposed depth increase of 12 feet, an additional 53 acres of land would be flooded. The decay of organic materials on this land may result in decreases in the DO levels within the hypolimnion and the discharge from the lake and increases in the levels of color and soluble nutrients. An increase in nutrients could allow the formation of algae blooms which could diminish the aesthetics of the area and add taste and odor to the water.

The death of vegetation in the newly inundated areas would also loosen the soil resulting in the accelerated sloughing of these soils when the pool is lowered. Much of the loosened soil would settle in the lake, but some would be discharged downstream. This increased sloughing and sedimentation will not affect the suitability of the water for water supply or recreation, but will diminish the aesthetics of the area.

e. Water Quality Conclusions.

Littleville Lake's good water quality may be somewhat degraded if emergency supplemental storage is formed; however, it will be adequate for municipal water supply after filtration and disinfection. Firefighting, irrigation, groundwater recharge and selected industrial needs will be met without treatment.

If the water at Littleville Lake was to be used for public water supply, a monitoring program should be implemented to monitor levels of heavy metals and coliform bacteria.

10. DISCUSSION OF IMPACTS

a. General

The following discussion serves only to identify potential impacts associated with the storage of drought waters. A more thorough review of the impacts to vegetation, fauna, and water quality would need to be performed if and when supplemental drought contingency storage is proposed. It is anticipated that an Environmental Assessment at the time could adequately address these issues.

b. Aquatic Ecosystem

Littleville Lake is located on the middle branch of the Westfield River in the Connecticut River Basin. It is surrounded by rough and rock hills with steep slopes, separated by narrow valleys which drain the streams towards the river. Littleville Lake is classified as a Lacustrine-Limnetic-Open water ecosystem by the U.S. Fish and Wildlife Service, National Wetlands Inventory.

Littleville Lake supports both a warm and cold water fisheries. The Massachusetts Division of Fish and Wildlife stock brown trout (Salmo trutta) and rainbow trout (Salmo gairdneri) for use by anglers. Some portion of the trout population may swim up the tributaries to spawn, however, it is not considered significant. About 20% of the trout stocked at Littleville escape downstream of the dam (John Parker, Project Manager-Littleville Lake, 1987). White suckers (Catostomus commersoni) and rainbow smelt (Osmerus mordox) also inhabit the lake.

Many warm water species, brown bullhead (Ictalurus nebulosus), yellow perch (Perca flavescens), largemouth (Micropterus salmoides) and smallmouth (Micropterus dolomieui) bass, occur in the project area. Chain pickeral (Esox niger), a species that would be expected to inhabit the project area, does not occur. The reasons for its absence are not known.

A comprehensive survey of aquatic vegetation has not been conducted. The excellent water quality and lack of shallow waters has limited the growth of algae blooms and aquatic weeds.

The present water supply pool is maintained year around and is a component of the city of Springfield's water supply system. The normal flood control gate settings during the nonfreezing season are two feet and two feet. The two flood control gates are submerged during the freezing season to prevent gate freezing.

A minimum release of 10 to 20 cfs is maintained during periods of flood regulation to maintain downstream water quality and fish life. The minimum outflow generally equals inflow during non-flood periods.

Emergency drought contingency storage could involve infringement on flood control storage of 3750 acre feet (ac -ft) or an additional stage of 12 feet. The supplemental storage would take place during spring runoff and it would not significantly impact flood control operations during the summer season.

Inundation of an additional 53 acres of land could affect water quality in the lake. Increased turbidity, reduced dissolved oxygen (DO) levels, and decreased pH from submersion of soils and vegetation are some of the anticipated impacts. An increased nutrient load could cause algal blooms and further reduce DO levels and/or lead to offensive tastes and odors (Bell, 1986).

Soil erosion is currently not a problem at Littleville Lake. However, drought storage plans may create new areas of erosion. Signs of erosion would need to be watched for and measures taken to alleviate the problem. Excessively silty water can effect the spawning abilities of fish such as bass and trout (Bell, 1986).

Submersed soils with a high organic content can cause a significant degradation of water quality (Ploskey, 1981). Low DO and low pH levels which can result could effect the aquatic community. Most warm water game fish cannot successfully reproduce at pH's below 4.5-6.0. DO levels below 6 milligrams/liter (mg/l) are limiting to warm water species and DO levels below 5 mg/l are limiting to cold water fisheries. Warm water fisheries are tolerant to a maximum temperature of 85°F and the maximum for a sustainable cold water fisheries is 68°F (Bell, 1986). The combined effects of untolerable temperatures, and low DO can cause reduced success with fish spawning, swimming speeds, and feeding requirements.

Restricted flows during drought storage could concentrate the aquatic community downstream into waters that may be experiencing high temperatures and low DO. This would result from drought conditions and low flow releases from the dam. These conditions could reduce the carrying capacity of the river. Parameters above the dam should be tested to minimize impacts to aquatic resources both above and below the dam.

Innundation and drawdown can have a positive effect on the fisheries if the above parameters are not limiting. Flooding of soils covered with leaves and herbaceous vegetation can provide a source of food for benthic detritivores (Ploskey, 1981). Flooding of terrestrial areas covered with vegetation can also enhance the number and quality of sites available for spawning, depending on the type of area inundated (Ploskey, 1983).

Predator fish can benefit from drawdowns in late summer and fall. Drawdowns force prey fish to leave the cover of inundated vegetation and also concentrates the prey fish, thereby increasing their availability to predators (Ploskey, 1981). This increases predator foraging and growth.

c. Project Operation and Recreation. In order to maintain supplemental storage at Littleville Lake above the current El. 518 FT-NGVD water supply pool, it would be necessary to regulate the gates. All costs associated with gate adjustment for drought storage, removal of abnormal amounts of floating debris at the log boom and removal of any vegetation that dies as a result of inundation would be the responsibility of the requestor. A pool above El. 518 FT-NGVD could also affect the use of existing recreational boat ramps. Any additional costs associated with further maintainance or modifications to the boat ramps would also be borne by the drought contingency storage requestor.

d. Wetlands and Upland Vegetation

The classes and subclasses of wetlands surrounding Littleville Lake are Palustrine - Scrub/shrub - Broad-leaved deciduous and Emergent vegetation, according to the U.S. Fish and Wildlife Service, National Wetlands Inventory Survey. The steep slopes surrounding the lake and deep waters preclude extensive growth of wetland vegetation. Approximately two acres of wetlands occur near the boat ramp on the east side of the dam. It is composed of cattails (*Typha* sp.) and reeds.

Forest lands cover approximately three quarters (1171 acres) of the project area. Four major cover types comprise 92 percent of the forested land. The most extensive cover type is hemlock - yellow birch (*Tsuga canadensis* - *Betula lutea*). Associates frequently encountered are black cherry (*Prunus serotina*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), basswood (*Tilia americana*), and white ash (*Fraxinus americana*). This type prefers the rich, moist site found throughout the project area.

The remaining most abundant cover types include sugar maple-beech-yellow birch (*A. saccharum* - *Fagus grandifolia*-*B. lutea*), northern red oak (*Quercus rubra*) and white pine (*Pinus strobus*). The sugar maple-beech-yellow birch is found with basswood, red maple, hemlock, northern red oak, white ash and white pine associates. This cover type prefers soils with good fertility and moisture. The northern red oak type occurs on the drier west and south facing slopes. White pine, red maple, sugar maple, beech, yellow and paper birch (*B. papyrifera*) are the principal associates. White pine, the last major cover type, includes associates of hemlock, paper birch, black birch (B. lenta), yellow birch, black cherry and basswood.

The major effect of flooding on soils is the creation of an anaerobic environment around the plant roots (Teskey and Hinckley, 1977). This produces several changes in the soil chemistry. Oxygen debt around the roots, carbon dioxide (CO_2) accumulation, and production of toxins are the result of an anaerobic environment in the soil (Whitlow, 1979). Species unable to tolerate these conditions will decrease their growth rate or cease to exist.

Flooding will determine species composition by selecting those species tolerant to flooding. Red maple is a species tolerant of deep flooding for one growing season but will experience significant mortality if flooding is repeated the following year. Basswood, white ash, and northern red oak are slightly tolerant of flooding, that is, able to survive flooding and saturated soils for 30 consecutive days during the growing season. Hemlock, yellow birch, black cherry, sugar maple, white pine and paper birch are species unable to tolerate flooding for more than a few days (Whitlow, 1979).

A 12 foot increase in lake waters, to accommodate storage of drought waters, would impact species not currently experiencing prolonged flood conditions during the growing season. Duration of flooding, frequency, time of year, water depth and siltation are critical in determining a plant's response to changes in water level (Teskey and Hinckley, 1977).

Flooding will have the greatest impact to vegetation during the growing season and the least impact during dormancy. Seedlings and immature specimens are generally intolerant of inundation (Whitlow, 1979). Loss of topsoil and erosion can reduce the success of seedlings colonizing the flood zone.

Fluctuation of water releases from the dam, in relation to drought storage and drought conditions, can stress the riparian vegetation downstream. The timing and duration of drought storage will effect the amount of change observed downstream.

e. Wildlife

Due to the mature dense canopy of forest surrounding Littleville Lake, understory cover is not extensive. Many wildlife species depend on ground cover and understory growth for food and cover.

Several species of wildlife occur in the project area. This includes white tail deer (Odocoileus virginianus), ruffled grouse (Bonasa umbellus), cottontail rabbit (Sylvilagus floridanus), wild turkey (Meleagris gallopairo), woodcock (Philehela minor) and gray squirrel (Sciurus carolinensis). The project area supports these and other species of wildlife.

Littleville Lake contains some open areas and abandoned fields adjacent to woodland. This habitat and the ecotone between an open habitat and forest attract many species of wildlife such as deer. Twigs of shrubs and trees and herbaceous plants are a major proportion of the deer diet. Acorns and other types of fruits supplement their diet. Gray squirrels are also partial to hardwood forest fruits such as acorns, beech nuts and hickory nuts (Martin et. al., 1951).

Cottontail rabbits, and ruffled grouse prefer foliage and tender herbaceous plants. The wild turkey and woodcock are not limited to just seeds and fruits, but will also eat animals. This includes beetles, grasshoppers, crickets, spiders, caterpillars, and other insects. Woodcocks prefer earthworms and insects (Martin et. al., 1951).

The limited wetland area at Littleville Lake reduces the amount of food and area for nesting and brood rearing of waterfowl species. The lake is used though, as a resting area for waterfowl during their seasonal migrations.

Wildlife most affected by the fluctuating water from drought storage are those species dependent on the shoreline for food and breeding. Species would include waterfowl, muskrats, otters and beavers. The amount of use of this area by these species is not known. Due to the lack of extensive marshy areas within the project site, the number of species which would be expected to utilize these areas would not be high.

The extensive tract of mature closed canopy forests at Littleville Lake should provide enough habitat for upland species displaced by the fluctuating waterlevel. These species prefer mature woods and open lands.

f. Threatened and Endangered Species

According to the U.S. Fish and Wildlife Services, except for occasional transient species, no known Federally threatened or endangered species are known to exist. Coordination with the Massachusetts Natural Heritage reveal no known State rare species in the project area.

g. Historical/Archaeological Resources

Emergency supplemental water supply storage could increase the pool at Littleville to elevation 530 feet. There are 16 historic sites located in the project area. Fourteen of these sites are located below spillway crest 576 feet. Five of these sites would be affected by an increase in pool elevation from 518 to 530 feet. Four of these sites are pre-1870 residences, and one is a pre-1894 structure. An archaeological evaluation and determination of National Registry eligibility of these sites, in order to comply with the requirements of the National Historic Preservation Act and the Archaeological Resources Protection Act has not been performed.

There are no recorded prehistoric archaeological sites in the project area. The steep topography of the area would not be favorable for prehistoric settlement. Therefore, the area to be affected by any increase in pool elevation has low potential to contain prehistoric sites.

11. SUMMARY AND CONCLUSIONS

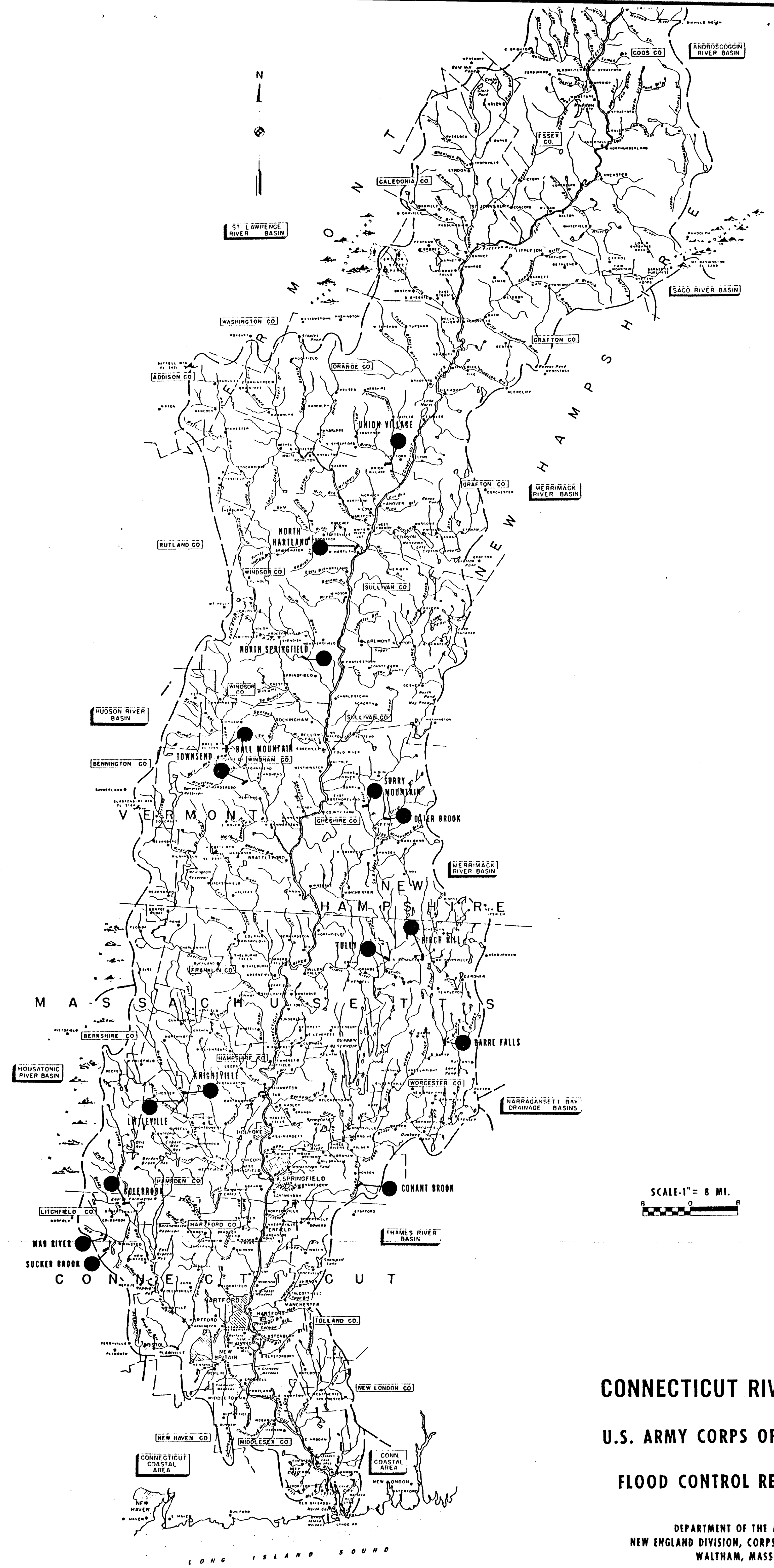
Littleville Lake is located on the Middle Branch, Westfield River in central Massachusetts in a region where 13 public water supply systems service about 174,000 people. Water supply storage is already included as a project purpose at Littleville Lake. The use of this storage and accompanying water rights belong to the city of Springfield. It has been estimated that the water resources at the site, in concert with the allotted storage would provide a dependable yield of about 17.5 MGD. Because of the city of Springfield's water rights, any supplemental drought contingency storage plans at Littleville, after commencement of a drought emergency, would likely be precluded.

Emergency supplemental drought contingency storage might be possible by filling some of the flood control storage above El. 518 FT-NGVD during spring runoff if and when the project water supply storage is refilled to 518 FT-NGVD. It has been determined that, infrequently, flood control storage in the amount of 3,750 AC-FT (up to El. 530 FT-NGVD) could be made available seasonally (late spring - early summer) without significantly impacting on flood control operations. Supplemental storage could impact existing vegetation around the periphery of the existing lake and impact the existing boat ramps and boat fishing access to the lake.

Littleville Lake's water quality is good. Supplemental storage could slightly degrade the existing water quality, however with filtration and disinfection it would be acceptable for public water supply.

Water supply withdrawals and minimum downstream releases from the project during a drought could affect aquatic life both in the reservoir and downstream. There could be other related environmental impacts. A review of all current applicable environmental, riparian or other laws would be required at the time of any decision to pursue drought contingency storage at the project.

The Corps of Engineers would not consider drought storage activities at Littleville Lake without an official request from the Commonwealth of Massachusetts.



CONNECTICUT RIVER BASIN

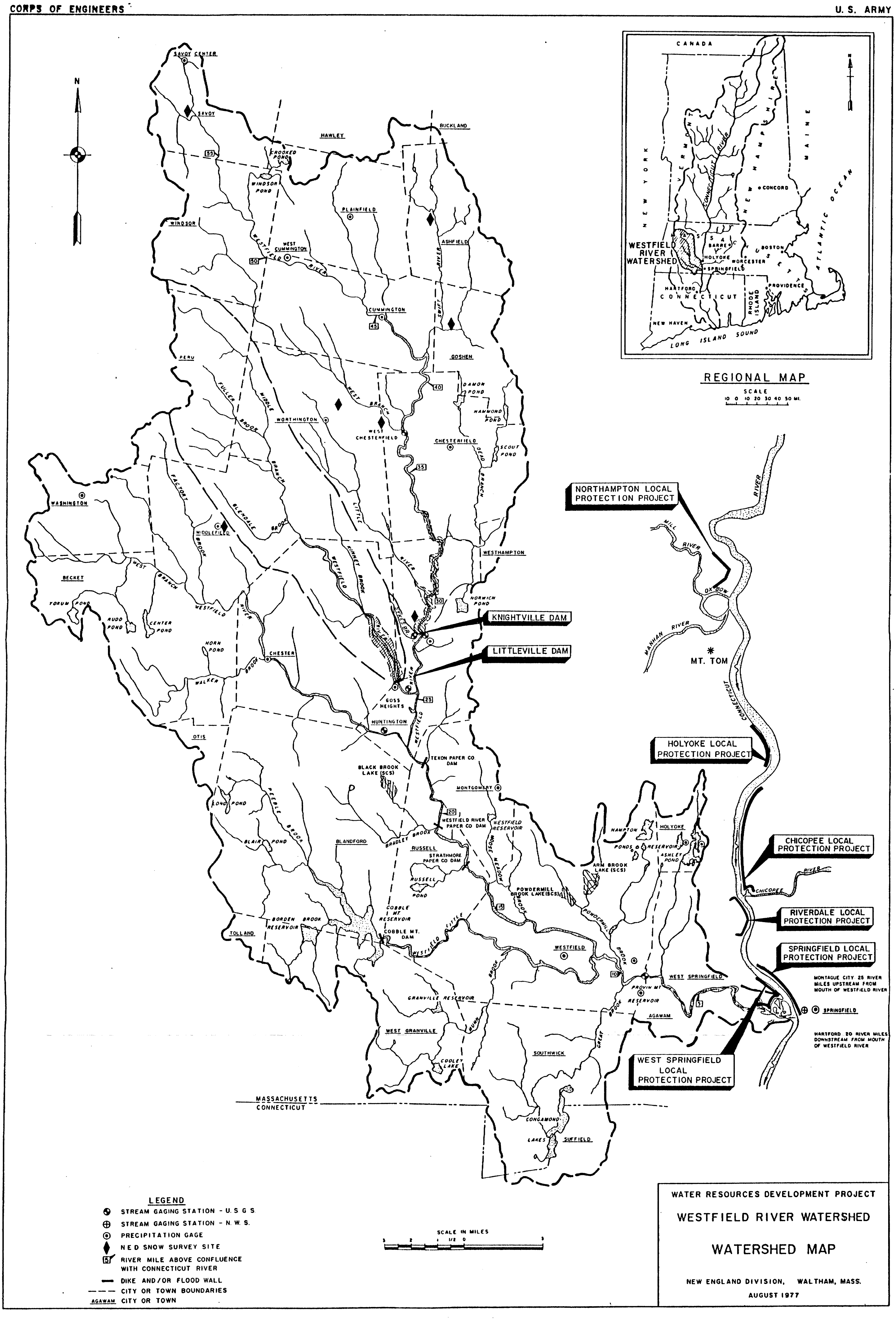
U.S. ARMY CORPS OF ENGINEERS

FLOOD CONTROL RESERVOIRS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

JANUARY 1981

PLATE I


REGIONAL MAP
CANADA
NEW YORK
VERMONT
NEW HAMPSHIRE
MAINE
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
ATLANTIC OCEAN
LONG ISLAND SOUND
CONCORD
BOSTON
WORCESTER
HOLYOKE
SPRINGFIELD
HARTFORD
PROVIDENCE
NEW HAVEN
WESTFIELD RIVER WATERSHED
NORTHAMPTON LOCAL PROTECTION PROJECT
KNIGHTVILLE DAM
LITTLEVILLE DAM
HOLYOKE LOCAL PROTECTION PROJECT
CHICOPEE LOCAL PROTECTION PROJECT
RIVERDALE LOCAL PROTECTION PROJECT
SPRINGFIELD LOCAL PROTECTION PROJECT
WEST SPRINGFIELD LOCAL PROTECTION PROJECT
MT. TOM
MONTAGUE CITY 28 RIVER MILES UPSTREAM FROM MOUTH OF WESTFIELD RIVER
HARTFORD 20 RIVER MILES DOWNSTREAM FROM MOUTH OF WESTFIELD RIVER
MASSACHUSETTS
CONNECTICUT
LEGEND
STREAM GAGING STATION - U.S.G.S.
STREAM GAGING STATION - N.W.S.
PRECIPITATION GAGE
N E D SNOW SURVEY SITE
RIVER MILE ABOVE CONFLUENCE WITH CONNECTICUT RIVER
DIKE AND/OR FLOOD WALL
CITY OR TOWN BOUNDARIES
AGAWAM CITY OR TOWN
SCALE IN MILES
WATER RESOURCES DEVELOPMENT PROJECT
WESTFIELD RIVER WATERSHED
WATERSHED MAP
NEW ENGLAND DIVISION, WALTHAM, MASS.
AUGUST 1977

LITTLEVILLE LAKE
AREA AND CAPACITY
(Drainage Area = 52.3 Square Miles)

Elevation (msl)	Stage (ft)	Area (acres)	Capacity Ac/Feet	Capacity Inches	Elevation (msl)	Stage (ft)	Area (acres)	Capacity Ac/Feet	Capacity Inches
WATER SUPPLY POOL									
432	0	0	0	0	480	48	120	2200	.79
435	3		15	.005	485	53	138	2800	1.00
440	8		25	.009	490	58	155	3600	1.29
445	13		75	.03	495	63	175	4400	1.56
450	18	25	150	.05	500	68	195	5300	1.90
455	23	38	230	.08	505	73	220	6200	2.22
460	28	50	400	.14	510	78	243	7300	2.62
465	33	67	700	.25	515	83	268	8500	2.62
470	38	85	1200	.43	518	86	275	9400	3.37
475	43	100	1700	.61					
FLOOD CONTROL POOL									
518	86	275	0	0	547	115	397	10000	3.58
519	87	280	314	.11	548	116	400	10400	3.73
520	88	283	628	.22	549	117	404	10800	3.87
521	89	285	943	.34	550	118	407	11200	4.02
522	90	290	1258	.45	551	119	411	11625	4.17
523	91	295	1563	.56	552	120	415	12050	4.32
524	92	300	1868	.67	553	121	420	12475	4.48
525	93	305	2174	.78	554	122	423	12900	4.63
					555	123	427	13332	4.78
526	94	310	2480	.89					
527	95	315	2797	1.00	556	124	430	13765	4.94
528	96	320	3115	1.12	557	125	435	14197	5.09
529	97	324	3432	1.23	558	126	438	14630	5.25
530	98	328	3750	1.34	559	127	443	15072	5.41
					560	128	446	15515	5.56
531	99	332	4090	1.47					
532	100	337	4430	1.59	561	129	450	15957	5.72
533	101	340	4770	1.71	562	130	454	16400	5.88
534	102	345	5110	1.83	563	131	457	16865	6.06
535	103	350	5470	1.96	564	132	461	17370	6.23
					565	133	466	17855	6.42
536	104	354	5830	2.09					
537	105	357	6190	2.22	566	134	470	18340	6.58
538	106	361	6550	2.35	567	135	475	18797	6.74
539	107	365	6922	2.48	568	136	478	19255	6.91
540	108	370	7295	2.62	569	137	482	19712	7.07
					570	138	485	20170	7.23
541	109	375	7667	2.75					
542	110	378	8040	2.88	571	139	490	20670	7.42
543	111	382	8430	3.02	572	140	495	21170	7.59
544	112	385	8820	3.16	573	141	498	21670	7.77
545	113	390	9210	3.30	574	142	502	22170	7.95
					575	143	508	22682	8.14
546	114	393	9600	3.44					
					576	144	510	23000	8.32

Crest Elevation = 576

PERTINENT DATA
LITTLEVILLE LAKE

July 1977

LOCATION — Middle Branch Westfield River; Chester and Huntington, Mass.

DRAINAGE AREA — 52.3 Square Miles

STORAGE USES — Flood Control, Water Supply

RESERVOIR STORAGE

	Elevation (ft msl)	Stage (ft)	Area (acres)	Acre-Feet	Inches on Drainage Area
Bottom of Water Supply Pool	432	0	0	0	0
Bottom of Flood Control Pool	518	81	275	9,400	3.4
Spillway Crest	576	144	510	23,000 (net)	8.3 (net)
Maximum Surcharge	591	159	584	31,200 (net)	11.2 (net)
Top of Dam	596	164	-	-	-

EMBANKMENT FEATURES

Type	Rolled rock and earth fill, rock slope protection, impervious core
Length (feet)	1,360
Top Width (feet)	25.0
Top Elevation (ft msl)	596
Maximum Height (feet)	164
Volume (cubic yards)	1,900,000
Dike	Left abutment - 935' long by 46' high

SPILLWAY

Location	Left abutment
Type	Ogee weir, chute spillway
Crest Length (feet)	400
Crest Elevation (msl)	576
Surcharge (feet above crest)	15

SPILLWAY DESIGN FLOOD

	Original Design
Peak Inflow (cfs)	98,000
Peak Outflow (cfs)	92,000
Volume Runoff (acre-feet)	62,500

OUTLET WORKS

Flood Control

Type	Horseshoe conduit
Tunnel Diameter (ft)	8
Tunnel Length (ft)	374
Gate Type	Electronically Operated Sluice
Gate Size	Two - 4' wide x 8' high
Invert Elevation (ft msl)	513(1)
Downstream Channel Capacity	1,500 cfs +
Discharge at Spillway Crest	2,270 cfs

(1) Discharge channel drops from 518 feet msl at weir (bottom of flood control pool) to 513 feet msl at the gate

Water Supply (City of Springfield, Mass.)

Type	Concrete conduit
Tunnel Diameter (ft)	4
Tunnel Length (ft)	800

Gates

Gate (No.)	Size ("in Diam.)	Type	Invert Elevation
1 (inlet)	36	Sluice	502.2
2 "	36	Sluice	483.8
3 "	36	Sluice	465.4
4 "	36	Sluice	447.0
5 (outlet)	48	Butterfly Valve	432.0
6 (drain)	46x48	Sluice	432.0
7 (mud gate)	12	Sluice	432.0

LAND ACQUISITION

Fee Elevation (ft msl)	581
Fee (acres)	1,567
Easement (acres)	10
Clearing Elevation (ft msl)	523

MAXIMUM POOL

Date	Mar 1977
Stage (feet)	120.6
Elevation (msl)	548.6
Percent Full	46

UNIT RUNOFF

One Inch Runoff — 2,790 acre-feet

OPERATING TIME

Open/Close flood control gates — 5 feet/min

PROJECT COSTS (THROUGH FY 76) — $7,013,000

DATE OF COMPLETION — October 1965

MAINTAINED BY — New England Division, Corps of Engineers